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(54) Bezeichnung: Mehrschichtkondensator und Verfahren zu dessen Herstellung

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ORIGINAL INSPECTED

PATENTANSPRÜCHE :

1. Mehrschichtkondensator, bestehend aus einem dielektrischen Körper mit seitlich, durch Einschnitte voneinander beabstandeten Füßen, die mit einer lötfähigen Metallschicht versehen sind, welche bis zu den Auflageflächen reicht, d a d u r c h g e k e n n z e i c h n e t , daß der dielektrische Körper (1) an allen vier die Mantelfläche bildenden Schmalseiten (3) einen Einschnitt (2) besitzt, so daß an jeder Schmalseite (3) des dielektrischen Körpers (1) zwei Füße (4) und ein dazwischen liegender Einschnitt (2) ausgebildet sind.

2. Mehrschichtkondensator nach Anspruch 1, dadurch gekennzeichnet, daß der dielektrische Körper (1) eine quadratische Grundfläche besitzt.

3. Mehrschichtkondensator nach einem der Ansprüche 1 bis 2, dadurch gekennzeichnet, daß die Elektrodenbeläge (5) mit Zuleitungen (6) bis an auf der Grundfläche des dielektrischen Körpers (1) diametral gegenüberliegende Auflageflächen (7a,7b) der Füße (4) reichen, wobei im dielektrischen Körper (1) hintereinanderliegende Elektrodenbeläge (5) alternierend auf durch einen Einschnitt (2) voneinander räumlich und galvanisch getrennte Füße (4) herausge-

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leitet sind.

4. Mehrschichtkondensator nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß in an sich bekannter Weise nur zwei auf einer Schmalseite (3) des dielektrischen Körpers (1) befindliche Füße (4) mit einer lötfähigen Metallschicht (8) versehen sind.

5. Mehrschichtkondensator nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß alle, an die Schmalseitenkanten anschließenden Füße (4) mit einer lötfähigen Metallschicht (8) versehen sind.

6. Mehrschichtkondensator nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Einschnitte (2) in der Mitte zwischen zwei Füßen (4) verlaufen.

7. Mehrschichtkondensator nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß ihn eine elektrisch isolierende Umhüllung (9) umgibt, die nur zwei auf einer Schmalseite (3) des dielektrischen Körpers (1) befindliche Füße (4) herausragen läßt.

8. Mehrschichtkondensator nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß ihn eine elektrisch isolierende Umhüllung (9) umgibt, welche die Einschnitte (2) teilweise ausfüllt und alle Füße (4) herausragen läßt.

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9. Mehrschichtkondensator nach Anspruch 7 oder 8, dadurch gekennzeichnet, daß an die Umhüllung (9) im Bereich eines Einschnittes (2) zwischen aus der Umhüllung (9) herausragenden Füßen (4) eine Rippe (10) angeformt ist.

10. Mehrschichtkondensator nach Anspruch 9, dadurch gekennzeichnet, daß die Rippe oder die vier Rippen (10) nur in die Nähe der die Auflageflächen (7a,7b) zweier benachbarter Füße (4) verbindenden Ebene reicht, jedoch über die Gesamtdicke der Umhüllung (9) hinausragt.

11. Verfahren zur Herstellung eines Mehrschichtkondensators nach einem der vorher genannten Ansprüche, dadurch gekennzeichnet, daß die lötfähige Metallschicht (8) an den Füßen (4) des dielektrischen Körpers (1) durch Tauchen, Spritzen, Walzen oder Stempeln aufgebracht wird, die Vorderseiten (12) der Einschnitte (2) jedoch von der Metallschicht freibleiben.

12. Verfahren zur Herstellung eines Mehrschichtkondensators nach Anspruch 5, dadurch gekennzeichnet, daß der dielektrische Körper (1) in ein Metallisierungsbad getaucht und darin gedreht wird, derart, daß die Füße (4) mit einer lötfähigen Metallschicht (8) bedeckt sind, die Einschnitte (2) an ihren Vorderseiten (12) jedoch von der Metallschicht (8) freibleiben.

13. Verfahren nach einem der Ansprüche 11 oder 12, dadurch gekennzeichnet, daß die lötfähige Metallschicht (8) eine an sich bekannte Silberschicht ist.

D R A L O R I C
Electronic GmbH

8672 Selb, den 9. Oktober 1975
Z/P-Fi

Mehrschichtkondensator und Verfahren zu dessen Herstellung.

Die Erfindung betrifft einen Mehrschichtkondensator, bestehend aus einem dielektrischen Körper mit seitlich, durch Einschnitte voneinander beabstandeten Füßen, die mit einer lötfähigen Metallschicht versehen sind, welche bis zu den Auflageflächen reicht, und ein Verfahren zu dessen Herstellung.

Mehrschichtkondensatoren, insbesondere monolithische Keramikkondensatoren werden wegen ihrer relativ hohen Kapazität pro Volumeneinheit vorzugsweise überall dort eingesetzt, wo nur ein geringes Platz- bzw. Raumangebot für elektrische Kondensatoren in einer Schaltung vorhanden ist.

Aus der deutschen Auslegeschrift 1 764 214 ist ein derartiger Kondensator bekannt, bei welchem die Füße auf einer Schmalseite des dielektrischen Körpers angeformt sind, die Elektrodenbeläge

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einzelner dielektrischer Schichten abwechselnd bis an die Auflageflächen der Füße reichen und dort durch eine lötfähige Metallschicht zusammengeschaltet sind.

Diese und beispielsweise aus der deutschen Auslegeschrift 1 940 036 bekannte Bauform eines Kondensators bzw. eines kapazitiven Netzwerkes hat jedoch den Nachteil, daß infolge der Kleinheit derartiger Kondensatoren eine Ausrichtung für das Aufbringen der lötfähigen Metallschicht an seinen Füßen nur sehr schwierig zu realisieren ist. Ein weiterer Nachteil dieser bekannten Kondensatorbauform besteht darin, daß der Anwender beim Einsatz des Kondensators genau auf die Orientierung des Kondensators zur elektrischen Schaltung achten muß, damit die Füße des Kondensators mit ihren Auflageflächen auf Leitungszügen oder Kontaktflächen der Schaltung zu liegen kommen. Anderenfalls kann der Kondensator nicht in die Schaltung eingesetzt werden.

Der Erfindung liegt die Aufgabe zugrunde, alle diese Nachteile zu vermeiden und einen von Orientierungen jeglicher Art unabhängigen elektrischen Kondensator für den direkten Einsatz beispielsweise in Hybridschaltungen zur Verfügung zu stellen. Eine weitere Aufgabe der Erfindung liegt darin, die als Chipkondensatoren bekannten Mehrschichtkondensatoren gegen Feuchtigkeitseinflüsse und gegen mechanische Beschädigungen zu schützen ohne des Vorteiles der Chipbauform verlustig zu gehen.

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Die Lösung dieser Aufgabe erfolgt erfindungsgemäß dadurch, daß der dielektrische Körper an allen vier die Mantelfläche bildenden Schmalseiten einen Einschnitt besitzt, so daß an jeder Schmalseite des dielektrischen Körpers zwei Füße und ein dazwischen liegender Einschnitt ausgebildet sind. Vorzugsweise besitzt der dielektrische Körper eine quadratische Grundfläche, um ihn zweidimensional von jeder Orientierung unabhängig zu machen, so daß der beispielsweise dichtgesinterte monolithische Keramikkörper einfach in einer Vorrichtung der Fertigungsstation zugeführt werden kann, in welcher zwei in einer Schmalseitenebene liegende oder alle Füße mit einer lötfähigen Metallschicht versehen werden.

Diese lötfähige Metallschicht dient dazu, die Elektrodenbeläge mit Zuleitungen, welche bis an auf der Grundfläche des dielektrischen Körpers diametral gegenüberliegende Auflageflächen der Füße reichen, zusammenzuschalten, wobei im dielektrischen Körper hintereinanderliegende Elektrodenbeläge alternierend auf durch einen Einschnitt voneinander räumlich und galvanisch getrennt Füße herausgeleitet sind. Dabei brauchen nur zwei auf einer Schmalseite des dielektrischen Körpers befindliche Füße mit einer lötfähigen Metallschicht versehen sein; vorzugsweise können jedoch alle, an die Schmalseitenkanten anschließenden Füße mit einer lötfähigen Metallschicht versehen sein. Im letztgenannten Fall bleibt der erfindungsgemäße Kondensator auch noch nach der Metallisierung in vorteilhafter Weise von

einer zweidimensionalen Oreintierung unabhängig und kann in einfachster Weise weiteren Fertigungsstationen zugeführt bzw. dem Anwender direkt zur Verfügung gestellt und von diesem ohne auf eine bestimmte Orientierung achten zu müssen, in eine Schaltung eingesetzt werden.

Jeder Einschnitt zwischen zwei Füßen kann an einer beliebigen Stelle sein, vorzugsweise wird er sich jedoch in der Mitte, d.h. in der Symmetrieachse der Grundfläche des dielektrischen Körpers befinden, um zu gleich großen Auflageflächen zu gelangen. Zur Erhöhung der Feuchtesicherheit eines derartigen Kondensators kann ihn eine elektrisch isolierende Umhüllung umgeben, die nur zwei auf einer Schmalseite des dielektrischen Körpers befindliche Füße herausragen läßt; bei einer anderen Ausführungsform eines erfindungsgemäßen Kondensators umgibt den dielektrischen Körper eine elektrisch isolierende Umhüllung, welche die Einschnitte teilweise ausfüllt und alle Füße gleichmäßig herausragen läßt. Da diese Umhüllung mindestens drei in zwei verschiedenen Raumrichtungen liegende Einschnitte ganz oder teilweise ausfüllt, ist eine feste Haftung der Umhüllung am dielektrischen Körper gewährleistet.

Wo es zweckdienlich erscheint, kann an die Umhüllung im Bereich eines Einschnittes zwischen aus der Umhüllung herausragenden Füßen eine Rippe angeformt sein. Auf diese Weise kann während des Einlötens eines derartigen Kondensators ein Kippen auf die Grundfläche

verhindert werden. Um eine sichere Kontaktierung der lötfähigen Metallschicht der beiden in einer Ebene liegenden Auflageflächen der Füße zu gewährleisten, darf die Rippe nur in die Nähe der die Auflageflächen zweier benachbarter Füße verbindenden Ebene reichen, jedoch sollte sie über die Gesamtdicke der Umhüllung hinausragen. Die lötfähige Metallschicht an zwei oder an allen Füßen des dielektrischen Körpers kann durch Tauchen, Walzen, Spritzen oder Stempeln aufgebracht werden. Die Vorderteile des/der Einschnitte müssen jedoch zur galvanischen Trennung der Elektrodenbeläge unterschiedlichen elektrischen Potentials von der Metallschicht frei bleiben. Vorzugsweise wird der dielektrische Körper in ein Metallisierungsbad getaucht und darin gedreht, derart, daß die Füße mit einer lötfähigen Metallschicht bedeckt werden, die Vorderteile der Einschnitte jedoch von der Metallschicht freibleiben. Als lötfähige Metallschicht kommt eine Silberschicht oder jede andere bekannte und dafür geeignete Metallschicht in Frage.

Die mit der Erfindung erzielten Vorteile bestehen insbesondere darin, einen in seiner Herstellung von bestimmten Oreintierungen unabhängigen elektrischen Kondensator zur Verfügung zu haben, der ohne weitere Anschlußelemente in einfachster Weise direkt in elektrische Schaltungen eingesetzt werden kann und bei dem eine gegenüber herkömmlichen Chipkondensatoren erhöhte Feuchtesicherheit und mechanische Belastbarkeit gewährleistet werden kann.

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Ausführungsbeispiele der Erfindung sind in der Zeichnung dargestellt und werden im folgenden näher beschrieben. Es zeigen

Fig.1 eine räumliche Darstellung eines Kondensators,

Fig.2 zwei dielektrische mit Elektrodenbelägen versehene Schichten,

Fig.3 eine räumliche Darstellung eines Kondensators mit zwei lötfähig metallisierten Füßen,

Fig.4 eine räumliche Darstellung eines Kondensators, bei dem alle Füße lötfähig metallisiert sind,

Fig.5 einen Kondensator mit Umhüllung,

Fig.6 einen umhüllten Kondensator mit einer Rippe zwischen zwei aus der Umhüllung herausragenden lötfähig metallisierten Füßen,

Fig.7 eine Aufsicht gemäß Fig.6,

Fig.8 eine räumliche Darstellung eines umhüllten Kondensators mit an allen vier Schmalseitenkanten der Umhüllung herausragenden Füßen und

Fig.9 einen in eine elektrische Schaltung (Ausschnitt) eingesetzten umhüllten und mit Rippen versehenen Kondensator.

Fig.1 zeigt einen Kondensator, bestehend aus einem dielektrischen Körper 1, beispielsweise einem monolithischen keramischen Körper, der an allen vier die Mantelfläche bildenden Schmalseiten 3 einen Einschnitt 2 besitzt, so daß an jeder Schmalseite 3 zwei Füße 4 ausgebildet sind. Die Füße 4 sind mit einer lötfähigen Metallschicht 8

versehen, welche die Auflageflächen 7a und 7b bedeckt, welche jedoch die Vorderseite 12 der Einschnitte 2 nicht erreicht. Der dielektrische Körper 1 besteht aus einer vom gewünschten Kapazitätswert abhängigen Anzahl dielektrischer Folien 11, von denen zwei räumlich im dielektrischen Körper 1 aufeinanderfolgende in Fig. 2 dargestellt sind.

Die schraffiert dargestellten Elektrodenbeläge 5 reichen mit Zuleitungen 6 bis an auf der Grundfläche des dielektrischen Körpers 1 diametral gegenüberliegende Auflageflächen 7a und 7b, wobei im dielektrischen Körper hintereinanderliegende Elektrodenbeläge 5 alternierend auf durch einen Einschnitt 2 voneinander räumlich und galvanisch getrennte Füße herausgeleitet sind. Vorzugsweise ist die Begrenzung des Elektrodenbelages 5 von der Vorderseite 12 des Einschnittes 2 beabstandet um die elektrische Spannungssicherheit des Kondensators zu erhöhen. Um die Folienfläche optimal auszunutzen, können auch die Flächen im Bereich der Füße mit Elektrodenbelag bedruckt sein. Es versteht sich von selbst, daß bei der Herstellung erfindungsgemäßer Kondensatoren größere dielektrische Folien 11 mit einer Vielzahl gleicher oder ähnlicher Beläge 5 bedruckt werden und eine bestimmte von der gewünschten Kapazität abhängige Anzahl derartiger bedruckter dielektrischer Folien 11 aufeinandergestapelt werden, wonach in einem Stanzvorgang die einzelnen Kondensatoren ausgestanzt und weiterverarbeitet werden.

Fig.3 zeigt einen dielektrischen Körper 1 quadratischer Grundfläche mit in den Symmetrieachsen auf den Schmalseiten ausgebildeten Einschnitten 2, so daß sich an den Schmalseitenkanten Füße 4 ausbilden. An diesen Füßen 4 reichen die Zuleitungen 6 bis an die Auflageflächen 7a und 7b heraus, wobei zwei der insgesamt vier Fußpaare 4 mit einer schraffiert dargestellten lötfähigen Metallschicht 8 bedeckt sind, welche auch die Auflageflächen 7a und 7b umfaßt und dort die Elektrodenbeläge in bekannter Weise verschaltet. Um einen Kurzschluß zu vermeiden, darf die lötfähige Metallschicht 8 nicht bis in die Höhe der Vorderseite 12 eines Einschnittes 2 reichen.

Fig.4 zeigt eine andere Variante der lötfähigen Metallschicht 8 auf einem mit Einschnitten 2 versehenen dielektrischen Körper 1, welche beispielsweise durch Tauchen und Drehen des Körpers 1 in einer bekannten Metallisierungsfarbe hergestellt werden kann. Auch hier ist nur darauf zu achten, daß der dielektrische Körper 1 nur so weit in die Metallisierungsfarbe eingetaucht wird, daß die Vorderseite 12 der Einschnitte 2 zwischen den Füßen 4 ausreichend aus dem Metallisierungsfarbspiegel herausragen.

Fig.5 zeigt einen Kondensator, bei dem nur zwei mit einer lötfähigen Metallschicht 8 bedeckte, durch einen Einschnitt 2 voneinander getrennte Füße 4 des dielektrischen Körpers (strichliert dargestellt) aus einer elektrisch isolierenden Umhüllung 9 herausragen.

Fig.6 zeigt einen der Fig.5 entsprechenden Kondensator mit einer an die Umhüllung angeformten Rippe 10 zwischen den beiden aus der Umhüllung 9 herausragenden, mit einer löffähigen Metallschicht 8 versehenen Füßen 4.

Fig.7 zeigt eine Ansicht des Kondensators gemäß Fig.6 von unten. Dabei sind die aus der Umhüllung 9 herausragenden Füße 4, bzw. deren Auflageflächen 7a und 7b und die zwischen den beiden Füßen 4 verlaufende, über die Gesamtdicke der Umhüllung 9 hinausragende Rippe 11 zu erkennen.

Fig.8 zeigt einen Kondensator, bei dem die Umhüllung 9 die Einschnitte 2 teilweise ausfüllt, so daß alle vier Fußpaare 4 mit ihrer lötfähigen Metallschicht 8 bedeckt, aus der Umhüllung 9 herausragen. Dieser Kondensator kann mit beliebigen zwei Auflageflächen 7a und 7b direkt in eine elektrische Schaltung eingesetzt werden.

Einen derartigen Einsatz eines Kondensators in eine elektrische Schaltung, bestehend aus einem Trägerkörper 13 und Leitungszügen 14 bzw. Widerstandsbahnen 15 zeigt Fig.9. Bei dieser Kondensatorbauform - entsprechend Fig.8 - sind an die Umhüllung 9 Rippen 10 angeformt, die ein Kippen des Kondensators während des Einlötvorganges in die Schaltung verhindern. Diese Rippen 10 brauchen selbstverständlich nicht die hier dargestellte Form besitzen, sondern es ist jede andere denkbare Rippenform möglich.

PATENTANSPRÜCHE

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Leerseite

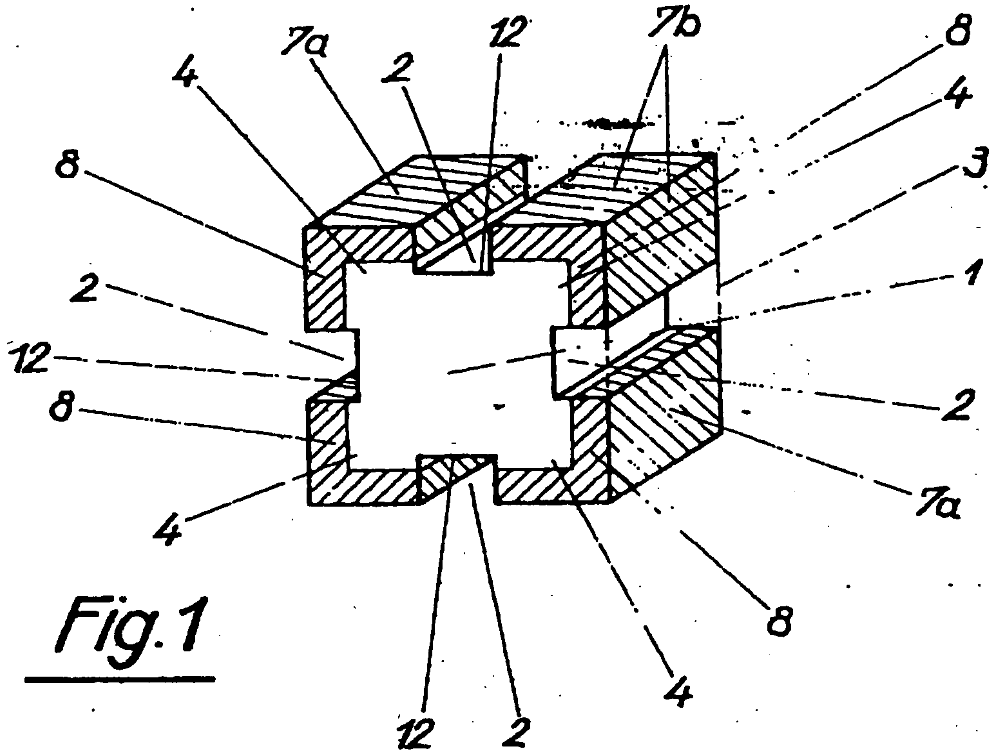

Fig.1

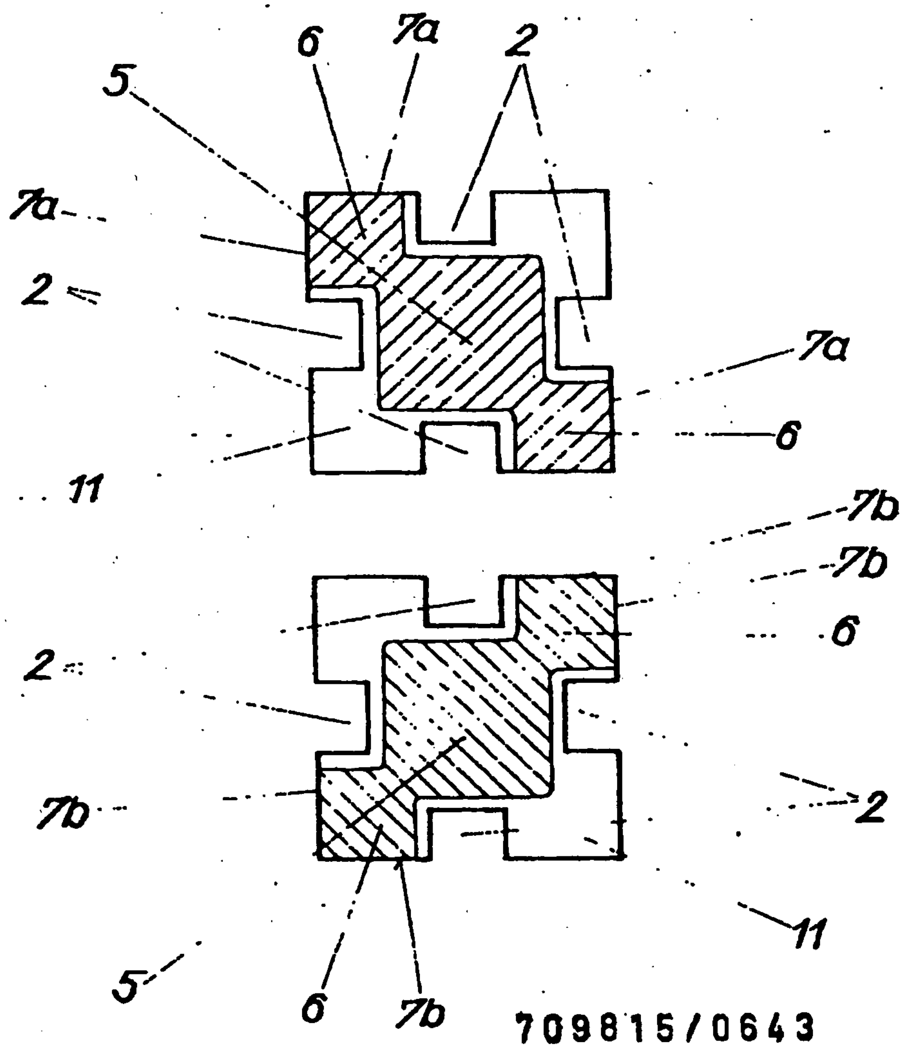

Fig.2

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Fig.3

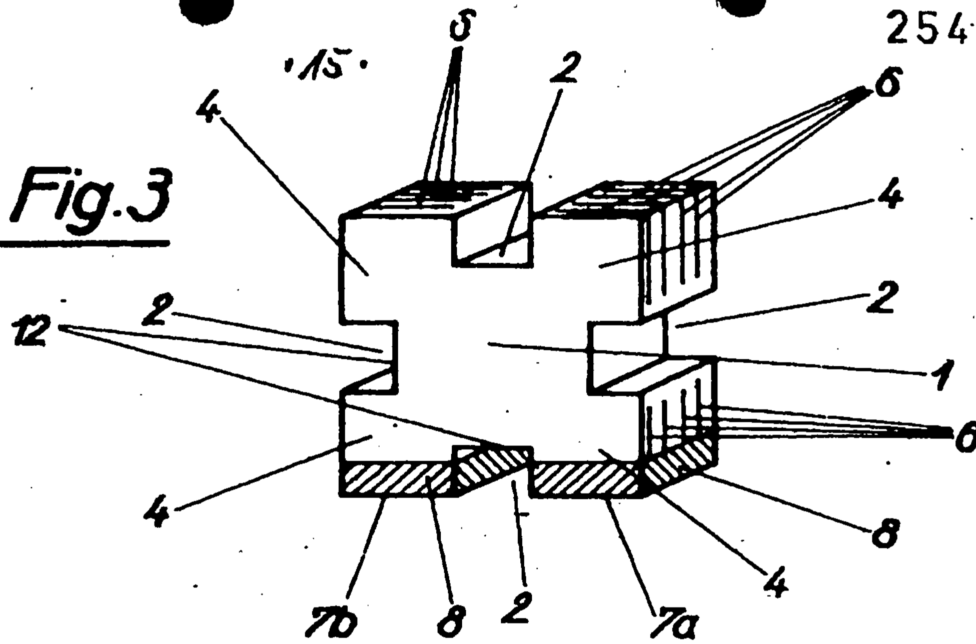
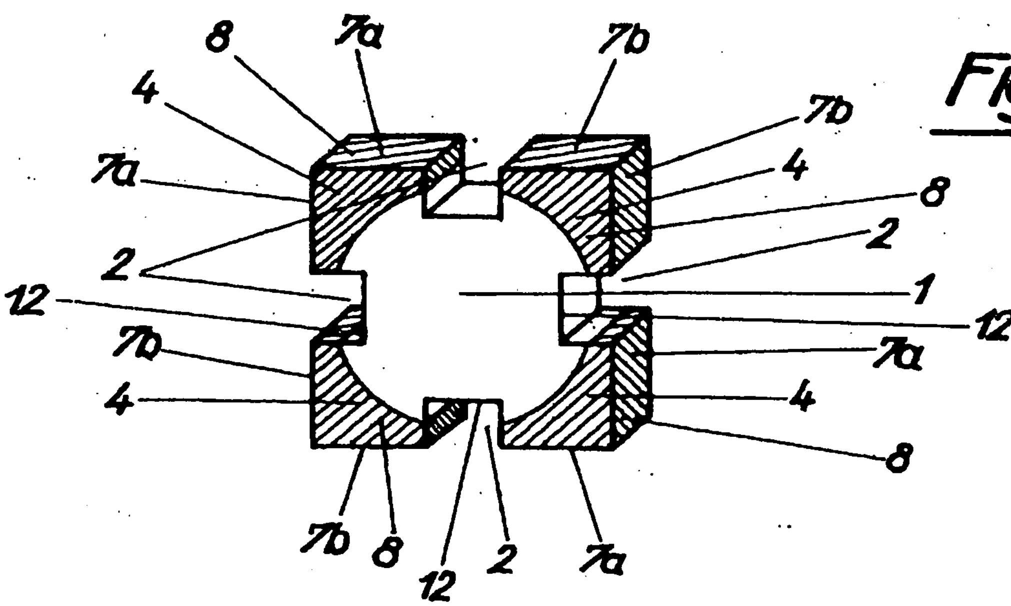


Fig.4



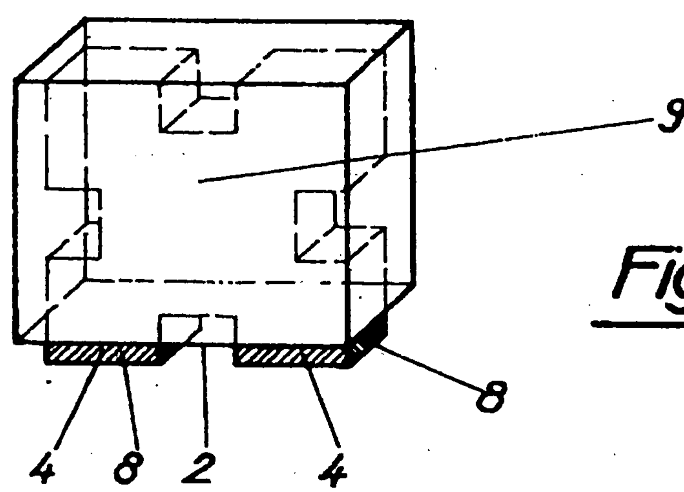
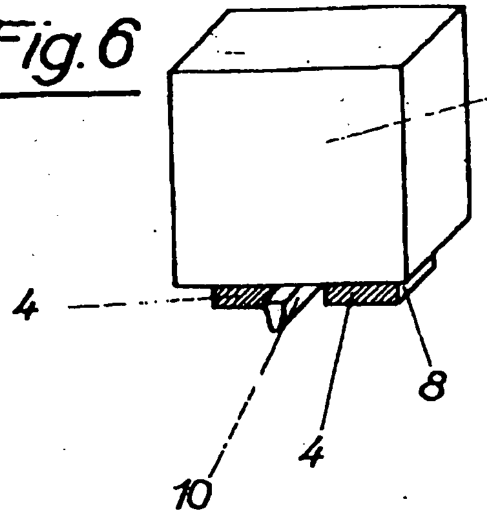


Fig.5

Fig. 6



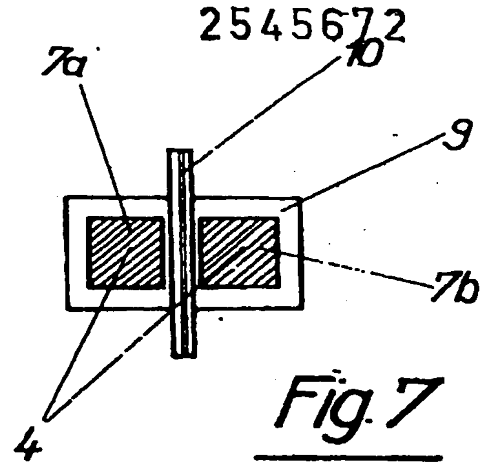


Fig. 7

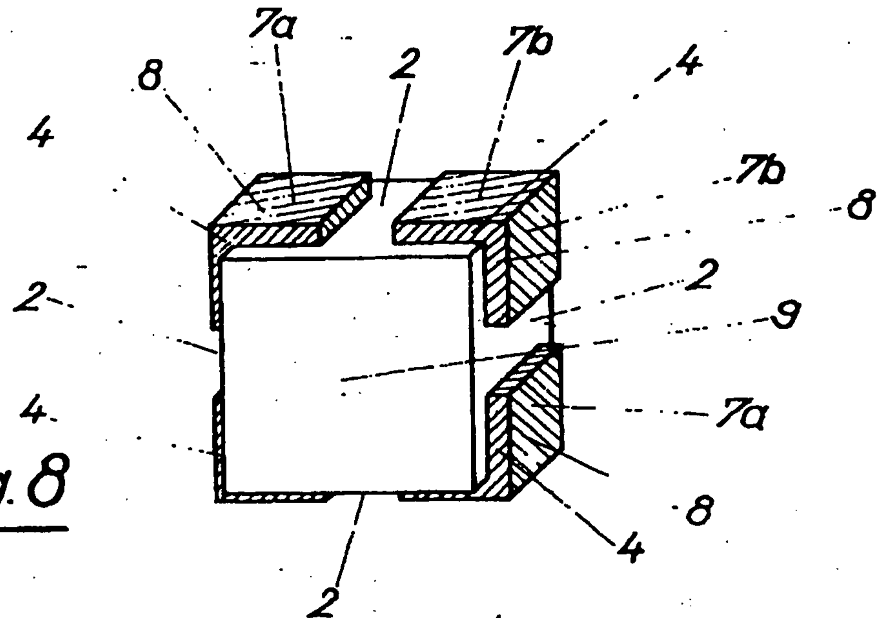


Fig. 8

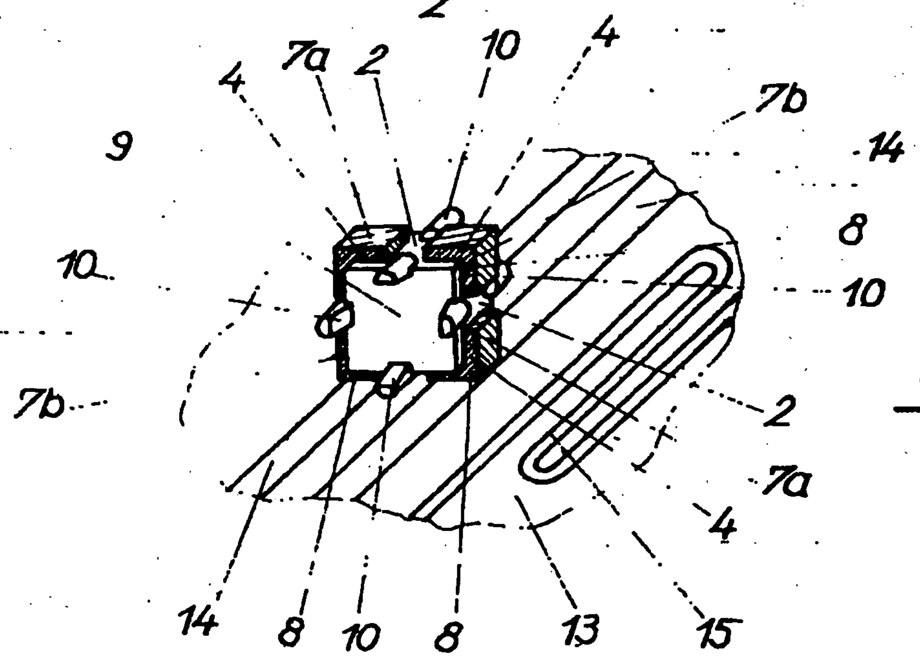


Fig. 9

MT0012-D

November 21, 2000

TRANSLATION INTO ENGLISH OF:
GERMAN OFFENLEGUNGSSCHRIFT 25 45 672

Date of filing : October 11, 1975
Applicant : Draloric Electronic GmbH
Application No.: P 25 45 672.8-33

A multilayer capacitor and a method of producing the same

The present invention relates to a multilayer capacitor consisting of a dielectric body with lateral legs spaced apart by grooves and provided with a solderable metal layer which extends up to the contact surfaces, and to a method of producing such a multilayer capacitor.

In view of their comparatively high capacitance per unit volume, multilayer capacitors, especially monolithic ceramic capacitors, are preferably used wherever only little space is available for electric capacitors in a circuit.

German-Auslegeschrift 1 764 214 discloses such a capacitor in the case of which the legs are formed on a narrow side of the dielectric body and the electrode coatings of individual dielectric layers extend alternately up to the contact surfaces of the legs where they are interconnected by a solderable metal layer.

This structural design of a capacitor and of a capacitive network, respectively, which is known e.g. also from German Auslegeschrift 1 940 036, has, however, the disadvantage that, due to the small size of such capacitors, an orientation for the application of the solderable metal

layer to its legs is very difficult to realize. A further disadvantage of this known capacitor design is that, when inserting the capacitor, the user must take great care that the capacitor is correctly oriented relative to the electric circuit so that the contact surfaces of the capacitor legs will be placed on conductors or contact areas of the circuit. Otherwise, the capacitor cannot be inserted into the circuit.

It is the object of the present invention to avoid all these disadvantages and to provide an electric capacitor which is independent of any kind of orientation and which is adapted to be inserted directly e.g. in hybrid circuits. A further object of the present invention is to protect the multilayer capacitors known as chip capacitors against the influence of moisture and against mechanical damage without losing the advantage offered by the chip design.

According to the present invention, this object is achieved by the features that the dielectric body is provided with a groove in each of the four narrow sides defining the outer surface so that two legs and an intermediate groove are formed on each narrow side of the dielectric body. The dielectric body preferably has a square base area so as to make it two-dimensionally independent of any orientation so that the e.g. densely sintered monolithic ceramic body can simply be supplied to a device of the production station in which two legs positioned in one narrow-side plane or all the legs are provided with a solderable metal layer.

This solderable metal layer serves to connect the electrode coatings to leads extending up to leg contact surfaces which are located on the base area of the dielectric body in diametrically opposed relationship with one another, electrode coatings succeeding one another in the dielectric body being alternatingly terminated on legs which are spatially and galvanically separated from one another by a

groove. It will suffice to provide two legs located on a narrow side of the dielectric body with a solderable metal layer; preferably, however, all the legs following the edges of the said narrow sides can be provided with a solderable metal layer. In the latter case, the capacitor according to the present invention will advantageously remain independent of a two-dimensinal orientation even after the metallization and can be supplied in a very simple manner to further production stations or it may directly be made available to the user who can insert said capacitor in a circuit without having to pay attention to a specific orientation.

Any groove between two legs can be at an arbitrary point, but preferably said groove will extend in the middle, i.e. in the symmetry axis of the base area of the dielectric body so as to obtain contact surfaces of equal size. In order to increase the moisture-proofness of such a capacitor, the capacitor can be enclosed by an electrically insulating cover, only two legs, which are located on one narrow side of the dielectric body, projecting beyond said cover; in accordance with another embodiment of the capacitor aaccording to the present invention, the dielectric body is enclosed by an electrically insulating cover, the grooves being partially filled by and all the legs extending uniformly beyond said cover. Since this cover fills, fully or partly, at least three grooves extending in two different spatial directions, it is guaranteed that the cover will firmly adhere to the dielectric body.

In cases where this seems to be expedient, a rib can be formed on the cover in the area of a groove between legs projecting beyond said cover. In this way, the capacitor can be prevented from tilting onto the base area, when it is being soldered into the circuit. In order to guarantee reliable contacting of the solderable metal layer of the two leg contact surfaces lying in one plane, the rib should extend only up to a point in the vicinity of the plane

interconnecting the contact surfaces of two neighbouring legs, but it should project beyond the total thickness of the cover. The solderable metal layer on two or on all legs of the dielectric body can be applied by dipping, rolling, spraying or stamping. The fronts of the groove(s) should, however, not be covered by said metal layer so as to galvanically separate the electrode coatings having different electric potentials. Preferably, the dielectric body is dipped into a metallization bath and rotated therein in such a way that the legs are covered with a solderable metal layer, whereas the fronts of the grooves will not be covered by said metal layer. Layers which can be used as a solderable metal layer are a silver layer or any other known metal layer which is suitable for this purpose.

The advantages achieved by the present invention especially are that an electric capacitor is provided, which is independent of specific orientations as far as its production is concerned, and which can directly be inserted into electric circuits in a very simple manner and without any additional connection elements being required, and in the case of which it can be guaranteed that the moisture-proofness and the mechanical stressability have been increased in comparison with that of conventional chip capacitors.

Embodiments of the present invention are shown in the drawing and will be described in detail in the following.

Fig. 1 shows a three-dimensional representation of a capacitor,

Fig. 2 shows two dielectric layers provided with electrode coatings,

Fig. 3 shows a three-dimensional representation of a capacitor with two legs which have been metallized so as to be solderable,

Fig. 4 shows a three-dimensional representation of a

capacitor in the case of which all the legs have been metallized so as to be solderable,

Fig. 5 shows a capacitor provided with a cover,

Fig. 6 shows a capacitor enclosed in a cover and provided with a rib between two legs which project beyond said cover and which have been metallized so as to be solderable,

Fig. 7 shows a view from below according to Fig. 6,

Fig. 8 shows a three-dimensional representation of a capacitor enclosed in a cover in the case of which legs project on each of the four narrow sides of the cover, and

Fig. 9 shows a capacitor enclosed in a cover and provided with ribs, in a condition in which it is inserted in an electric circuit (detail).

Fig. 1 shows a capacitor consisting of a dielectric body 1, e.g. a monolithic ceramic body, which has a groove 2 on each of the four narrow sides 3 defining the outer surface so that two legs 4 are formed on each narrow side 3. The legs 4 are provided with a solerable metal layer 8 which covers the contact surfaces 7a and 7b but which does not extend up to the front 12 of the grooves 2. The dielectric body 1 consists of a number of dielectric foils 11 which depends on the desired capacitance value, two of said foils 11, which spatially follow one another in the dielectric body 1, being shown in Fig. 2.

The cross-hatched electrode coatings 5 extend with leads 6 up to contact surfaces 7a and 7b which are located on the base area of the dielectric body 1 in diametrically opposed relationship with one another; electrode coatings 5 succeeding one another in the dielectric body are alternatingly terminated on legs which are spatially and galvanically separated from one another by a groove 2. Preferably, the boundary of the electrode coating 5 is spaced from the front 12 of the groove 2 so as to increase

the electric voltage safety of the capacitor. For an optimum utilization of the foil area, also the foils in the area of the legs can have printed thereon an electrode coating. It goes without saying that, when capacitors according to the present invention are produced, comparatively large dielectric foils 11 have printed thereon a large number of identical or similar coatings 5 and that a certain number of such printed dielectric foils 11 is stacked one on top of the other, whereupon the individual capacitors are cut out in a punching operation and subjected to further processing, the number of dielectric foils depending on the desired capacitance.

Fig. 3 shows a dielectric body 1 having a square base area and having grooves 2 formed therein in the symmetry axes on the narrow sides so that legs 4 are formed on the edges of said narrow sides. On these legs 4 also the leads 6 extend up to the contact surfaces 7a and 7b, two leg pairs 4 of the total number of four leg pairs 4 being covered with a solderable metal layer 8, which is shown as a cross-hatched area and which also comprises the contact surfaces 7a and 7b where it connects the electrode coatings in a manner known. In order to avoid a short circuit, the solderable metal layer 8 must not extend up to the level of the front 12 of a groove 2.

Fig. 4 shows a different variant of the solderable metal layer 8 on a dielectric body 1 provided with grooves 2; this variant can be produced e.g. by dipping the body 1 into and by rotating it in a known metallization colour. Also in this case, it will suffice to pay attention to the fact that the dielectric body 1 should be dipped into the metallization colour only to such an extent that the front 12 of the grooves 2 between the legs 4 projects sufficiently beyond the metallization colour surface.

Fig. 5 shows a capacitor in the case of which only two legs

4 of the dielectric body (cross-hatched) project beyond an electrically insulating cover 9, said two legs 4 being covered with a solderable metal layer 8 and separated by a groove 2.

Fig. 6 shows a capacitor corresponding to that of Fig. 5 and having a rib 10 formed on the cover, said rib being located between the two legs 4 projecting beyond the cover 9 and provided with a solderable metal layer 8.

Fig. 7 shows a view in which the capacitor according to Fig. 6 can be seen from below. The legs 4 projecting beyond the cover 9 and the contact surfaces 7a and 7b of said legs as well as the rib 10 extending between said two legs 4 and projecting beyond the total thickness of the cover 9 can be seen in this view.

Fig. 8 shows a capacitor in the case of which the cover 9 partly fills the grooves 2 so that all four pairs of legs 4, covered with the solderable metal layer 8, project beyond the cover 9. This capacitor can directly be inserted into an electric circuit with arbitrary two contact surfaces 7a and 7b.

Such an inserted condition of a capacitor in an electric circuit consisting of a carrier body 13 and conductors 14 as well as resistance tracks 15 is shown in Fig. 9. In the case of this structural design of the capacitor - according to Fig. 8 - the cover 9 has formed thereon ribs 10 which, when the capacitor is being soldered into the circuit, prevents said capacitor from tilting. It goes without saying that these ribs 10 need not have the shape shown in said Fig. 9 and that any other shape of said ribs is imaginable.

CLAIMS

1. A multilayer capacitor consisting of a dielectric body with lateral legs spaced apart by grooves and provided with a solderable metal layer which extends up to the contact surfaces, characterized in that the dielectric body (1) is provided with a groove (2) in each of the four narrow sides (3) defining the outer surface so that two legs (4) and an intermediate groove (2) are formed on each narrow side (3) of the dielectric body (1).

2. A multilayer capacitor according to claim 1, characterized in that the dielectric body (1) has a square base area.

3. A multilayer capacitor according to one of the claims 1 to 2, characterized in that the electrode coatings (5) extend with leads (6) up to leg contact surfaces (7a, 7b) which are located on the base area of the dielectric body (1) in diametrically opposed relationship with one another, electrode coatings (5) succeeding one another in the dielectric body (1) being alternatingly terminated on legs (4) which are spatially and galvanically separated from one another by a groove (2).

4. A multilayer capacitor according to one of the claims 1 to 3, characterized in that, in a manner known per se, two legs (4) located on a narrow side (3) of the dielectric body (1) are provided with a solderable metal layer (8).

5. A multilayer capacitor according to one of the claims 1 to 3, characterized in that all the legs (4) following the edges of the said narrow sides are provided with a solderable metal layer (8).

6. A multilayer capacitor according to one of the claims 1 to 5, characterized in that the grooves (2) extend in the middle between two legs (4).

7. A multilayer capacitor according to one of the claims 1 to 6, characterized in that the capacitor is enclosed by an electrically insulating cover (9), only two legs (4), which are located on one narrow side (3) of the dielectric body (1), projecting beyond said cover (9).

8. A multilayer capacitor according to one of the claims 1 to 6, characterized in that the capacitor is enclosed by an electrically insulating cover (9), the grooves (2) being partially filled by and all the legs (4) projecting beyond said cover (9).

9. A multilayer capacitor according to claim 7 or 8, characterized in that a rib (10) is formed on the cover (9) in the area of a groove (2) between legs (4) projecting beyond said cover (9).

10. A multilayer capacitor according to claim 9, characterized in that the rib or the four ribs (10) extend(s) only up to a point in the vicinity of the plane interconnecting the contact surfaces (7a, 7b) of two neighbouring legs (4), but project(s) beyond the total thickness of the cover (9).

11. A method of producing a multilayer capacitor according to one of the preceding claims, characterized in that the solderable metal layer (8) is applied to the legs (4) of the dielectric body (1) by dipping, spraying, rolling or stamping, whereas the fronts (12) of the grooves (2) will not be covered by said metal layer (8).

12. A method of producing a multilayer capacitor according to claim 5, characterized in that the dielectric body

(1) is dipped into a metallization bath and rotated therein in such a way that the legs (4) are covered with a solderable metal layer (8), whereas the fronts (12) of the grooves (2) will not be covered by said metal layer.

13. A method according to one of the claims 11 or 12, characterized in that the solderable metal layer (8) is a silver layer which is known per se.

Improved Method of Manufacturing Capacitors

The present invention relates to an improved method of manufacturing capacitors and in particular a method of manufacturing high voltage capacitors.

The current processes of manufacturing capacitors use metal sheets separated by a naked insulating layer and the whole is rolled up to a structure resembling a bobbin such that the metal layers hang over on one side to form the electrodes of the thus produced capacitor. The electrical connections are then made either by soldering or by simply pressing onto the extended metal parts. However, in order to obtain a capacitor with good technical characteristics it is necessary to roll the whole very tightly and insulate it by means of an insulating liquid such as oil, which impregnates the compact block thus produced.

Insulating by way of a liquid carries serious disadvantages with it, including the necessity for sealing the whole and maintaining it in a leak-proof container. Furthermore the bobbin structure imposed dictates the need for a certain volume which may also be disadvantageous.

To try to resolve these problems the present invention was created using a solid insulator The capacitor is fundamentally composed of two types of flat sheeting in juxtaposition: a sheet of metallic conductor and a sheet of insulating dielectric. These sheets are combined together and stacked.

Following a characteristic of the present invention, the afore mentioned flat fundamental structures are stacked, the metal sheets and the dielectric sheets, or merely the sheets of metallized dielectric, such that the space between two metal layers or metallized layers contain one, or more usually, many sheets of naked dielectric. The stack thus produced is then degassed and impregnated and the electrical connections between the metallized layers are metallized in the field to form each electrode.

Following another characteristic of the present invention, each metal sheet or the metal part of each sheet of metallized dielectric has a smaller size than the dielectric layer such that a margin of over-hang of the dielectric is created around the edges. This is the case for the whole perimeter except for a certain small area where the metal sheet or the metallization completely covers the insulating dielectric sheet. Here no over-hang is produced.

Following another characteristic of the present invention, the metal and the dielectric sheets, or the metallized dielectric sheets, are stacked such that the parts of the perimeter where the metal sheets emerge at the edge are aligned, the alignment being in a different position for the even numbered sheets and for the odd numbered sheets. This double alignment creates two parallel rows separated by a small distance imposed to prevent short circuiting. These two parallel rows are subsequently metallized to create two metallic ribbons which form the electrodes of the capacitor. According to the present invention the above description enables the manufacture of capacitors which have many advantages over those manufactured by other methods. These include the feasibility of having a capacitor with a smaller

volume, simpler geometric forms and good technical characteristics, notably at high voltages.

Other characteristics and advantages of the present invention will become apparent in the course of the following description, which is intended as a non-limiting example and is supplemented by a number of figures:

Figure 1: A fundamental component making up the odd numbered layers;

Figure 2: A fundamental component making up the even numbered components;

Figure 3: A diagram of a stack of the fundamental components from Figures 1 and 2;

Figure 4: A partial representation of a stack analogous to that in Figure 3 but where the dielectric sheet has a different shape;

Figure 5: A practical example of a stack of fundamental components in position and a fastening mechanism;

Figure 6: An example of a cylindrical high potential capacitor according to the present invention.

A capacitor according to the present invention is made starting with flat elements represented in Figures 1 and 2. The shaded area M corresponds to a metal sheet or metallized layer placed on a dielectric sheet D. The dimensions of these two sheets with different properties are such that they produce a margin A between the edges of the metal and the edges of the dielectric. The margin created by cutting the

sheets to different sizes or by carving the metallized dielectric sheets has an approximately constant width, with the dielectric area forming the outside edge and having a larger surface than the metal sheet. The metal sheet completely covers the dielectric sheet on only a small part of the peripheral edge, the areas P, and therefore no margin is created here. These areas will later make up the electrodes when the sheets of the capacitor are stacked one on top of the other. The metal sheets forming one electrode are placed as shown in Figure 1, which correspond, for example, to the odd numbered metal sheets. Those placed as shown in Figure 2 correspond then to the even numbered metal sheets. These zones are separated such that a constant distance d separates the even numbered zones P_{2n} from the odd numbered zones P_{2n+1} as shown in Figure 3. The distance can be determined for example by comparing to an axe of symmetry in the flat plane of the fundamental component. The distance between the P zones is minimized taking into account the required distance to prevent short circuiting in the capacitor.

As an improvement on this, this distance can be made even smaller by employing a dielectric sheet of a particular shape. This shape is partially represented by Figure 4, where a small extension B is made on the edge of the dielectric sheet. This extension extends the line of current between the odd numbered and the even numbered P zones which make up the electrodes. The new line of current goes from the original value d without the presence of the extension to the new value of $d_1 + d_2 + d_3$ created by the periphery of the extension B.

It should be evident that the square shape used for the fundamental components is only meant as an example and represent no limitations to the present invention whatsoever.

The perimeter of the component sheets can take any polygonal shape required. The capacitor produced has a corresponding prismatic shape, cubic for square components, cylindrical for circular components etc.

Depending on the technical characteristics required for the capacitor, one, or more often, several sheets of dielectric are placed between two adjacent metal sheets or between two adjacent sheets of metallized dielectric.

The metal and dielectric sheets are shaped to the desired form by cutting. In the case of the sheets of metallized dielectric the margin between the metal edge and the dielectric edge can be obtained by chemical carving.

The capacitor is produced according to the following technique: the sheets of metallized dielectric or the metal sheets are stacked by placing alternately one odd numbered sheet and one even numbered sheet - these differ one from the other merely by the position of their P area - and by placing between two adjacent metallic layers a convenient number of naked insulating dielectric layers. The whole is stacked without the use of pressure and such that the areas P_{2n} of the even numbered layers are aligned and the areas P_{2n+1} of the odd numbered layers are also aligned. Where the metal sheet emerges on the block's edge, two vertical bands of metal are produced in the field as shown by Figure 3. The block is placed in a container under vacuum and degassed and is then impregnated with a polymerisable resin. In order to obtain a good vacuum the stack is kept such that the flat layers are in a vertical position and the vacuuming procedure is carried out in successive cycles: put under vacuum in the container, and compressed with an appropriate mechanism. Once under vacuum the block is impregnated at an suitable temperature

which can be held constant within the enclosure. The impregnated block thus produced is removed from the container and the polymerisation takes place at ambient temperature.

In order to effect the stacking and the degassing processes easily, the fundamental components can be fitted with positioning indicators. One such example can be seen in Figure 5 where the positioning indicators are represented by the holes t_1, t_2, t'_1, t'_2, which are placed close to the periphery of the component. Guiding axes T1, T2, T'1, T'2 can be slid into these holes. These pieces all project out of a base platform C1 and are able to penetrate a second platform C2. If C1 is approached to C2 and tightened the stack can be pressed together. The tightening mechanism is not shown but could be carried out, for example, with the help of a hydraulic press.

If the fundamental components comprise a juxtaposition of metal and dielectric sheets, each sheet is positioned by the presence of a number of holes, the metallic sheets have two diagonal holes, those composed of 2 zones which cover the dielectric P_{2n} and P'_{2n} for the metal layer numbered 2n, and P_{2n+1}, and P'_{2n+1} for the layers numbered 2n+1. The dielectric sheet or sheets placed between these, D_{2n} or D_{2n+1} contain all four positioning holes. If the fundamental components comprise only metallized dielectric sheets it is not necessary to plan the zones P'_{2n} or P'_{2n+1} since the metallized area here is part of the dielectric layer. It is important, however, that the number of holes that are put into the margin A and therefore solely in the dielectric are sufficient in number and correctly positioned to ensure good tightening.

After the impregnation has solidified the sides of the block are adjusted by machine, in particular those sides containing a metal area emerging at the edge, i.e. in the areas without a margin. Adjustment can also include removing those parts of the periphery which contain holes or positioning indicators. The areas where the metal emerges are then joined together by metallization of the relevant side or sides of the block. In general the method employed is a chemical metallization followed by an electrolytic metallization. The two close, lateral bands thus obtained make up the electrodes of the capacitor. External electrical connections can then be soldered onto these.

The lifetime of the block thus made can be extended by draping a material around it or by covering it with a coiled structure. The best reinforcing material for this is an epoxy glass, ror example.

The fundamental flat components needed to make such a capacitor include: a sheet of metal or a metallized sheet, the metal in both cases being copper, whose thickness should ideally be a few tens of microns thick, and a dielectric sheet made for example of a polycarbonate, whose thickness is determined by the required characteristics of the capacitor and which has certain desirable properties. These desirable properties are electrical in character and include: a dielectric constant sufficiently stable and independent of temperature, low loss, a sufficiently rigid dielectric at a range of temperatures; and mechanical characteristics which include notably a good anchorage with the metal of the metallization or with the metal sheet, with the impregnating product and, should the occasion arise, with the reinforcing material.

An embodiment of a capacitor according to the present invention is represented by Figure 6 and concerns a capacitor of cylindrical form as a result of the circular shape of its flat fundamental component. This capacitor has a capacitance of 0.28 μF and can withstand a voltage of 12kV. The circle has a surface of approximately 446 cm^2 which corresponds to a diameter of 25cm. It is approximately 1.1 cm thick.
This capacitor is stacked with 49 layers which have been metallized with copper and which have a thickness of 35 microns, and 240 insulating layers, the 48 intervals between two adjacent metallic layers each house 5 sheets of polycarbonate, each polycarbonate layer being 40 microns thick.

A variation of the proposed invention concerns the metal sheets having P areas which do not emerge on to the edge of the dielectric, but rather go beyond it. In this case the electrodes and the external electrical connections are made by appropriate soldering and / or pressing onto these extensions.

We have thus described the production of a capacitor which alleviates and corrects the difficulties and faults encountered by current capacitors, these latter not always allowing us to take full advantage of the properties of the dielectric used in particular, and furthermore not always making a good insulation. Note should be taken of the simplicity of the methods employed, which consist of stacking flat metal, dielectric or metallized dielectric components by placing an appropriate number of dielectric layers between two layers of metal, degassing the block thus produced and impregnating it in vacuo. The block is then taken by machine and metallized in the field to form electrodes. It should

also be noted that the method described is useful for producing high voltage capacitors, or those with a small volume and result in good technical characteristics notably a very weak inductance mainly due to the way in which the electrical connections are created.

This method of production allows the capacitor to take on any prism shape desired, the final shape being dependent on the shape of the fundamental components used, a circular base structure giving rise to a cylindrical capacitor, etc.

It should be understood that the description given above is only intended as a non-limiting example and that all changes to the shape, to the assembly, or to the number of components described, but that simultaneously do not alter the principal characteristics of the present invention will be comprised within the scope of this invention.

Summary

An improvement on the production of capacitors by employing principally the following points either separately or combined:

1. Capacitors made from flat components consisting of either metallized dielectric sheets or by stacking alternate layers of metal and dielectric, the components mentioned being combined and stacked such that between two layers of metal or two metallized layers there is one or more layers of dielectric, the stack thus produced allowing the use of a solid rather than a liquid insulation and the electrical connections between the different metallic layers are made by metallizing in the field to form the electrodes;

2. Capacitor according to 1., wherein the metal sheets or the metallized layers are of such size as to allow a margin of extension of the dielectric all around the perimeter except for a small area where the metal covers the dielectric to the edge;

3. Capacitor according to 2., wherein the areas of the perimeter having both the metal layer or the metallized layer superimposed on the insulating dielectric layer are situated in two different positions separated by a given distance;

4. Capacitor according 3., wherein stacking is carried out such that the areas where the metal layer emerges on the border with the dielectric are aligned, one line for the even numbered metal layers and one line for the odd numbered metal layers. This creates two parallel rows in the field separated by a given distance;

5. Capacitor according to 3., wherein the distance of separation between the electrodes is minimized, taking into account the danger of short circuiting the capacitor;

6. Capacitor according to 1., wherein the flat fundamental component has the shape of any polygon, the resulting capacitor having thus the shape of the corresponding prism;

7. Capacitor according to 4., wherein the block is simultaneously degassed and pressed and then impregnated in vacuo with a polymerisable resin at a suitable temperature. Polymerisation then happens at ambient temperatures;

8. Capacitor according to 7., wherein after adjustment of the relevant surfaces by machinery the metal emerging on the periphery of the even numbered layers is connected up by metallization of the stack to make up the first electrode, the metal emerging on the periphery of the odd numbered sheets are similarly connected up by metallization to form the second electrode;

9. Capacitor according to 8., wherein first chemical metallization is carried out followed by electrolytic metallization;

10. Capacitor according to point 1, wherein the dielectric material used is preferentially a polycarbonate;

11. Improving the capacitor according to 5., wherein the dielectric sheets are cut along the sides where the metal emerges on the periphery such that insulating extensions are made between the odd and even areas, thereby allowing the distance between the electrodes to be minimized while simultaneously elongating the line of current;

12. Capacitor according to 1., enveloped in a protection which is either draped around it or has a bobbin-like structure, the protecting material being preferentially an epoxy glass;

13. A variation of a capacitor according to 1., wherein the part of the perimeter containing the metal sheet or the metallization not only completely covers the insulating dielectric sheet but extends a certain distance past it, producing a stack of extensions which can be soldered and/or pressed to form electrodes;

14. Capacitor realized according to any one, any combination or all preceeding points described.